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CONSERVANCY
OR
DRY SANITATION
VERSUS
WATER CARRIAGE

By J. DONKIN,
Fel. Roy. Inst. Brit. Archts.

E. & F. N. SPON, LIMITED,
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INTERCEPTION
VERSUS
WATER CARRIAGE.

"For nought so vile that on the earth doth live,
But to the earth some special good doth give."
—*Romeo and Juliet.*

THIS saying, for which one of the world's wisest men is responsible, has a close and vital connection with the matter in hand. All things are born out of the earth, and back to the earth all things must tend. From the corruption of death she brings forth new life; and the graves of one season become the cradles of the next. Those who are inclined to think the disposal of refuse an unclean or an unsavoury subject should remember that the whole edifice of nature rises from the soil; that dirt and refuse properly used result in food and wages, and equally so (though, perhaps, less directly), in streams of whose waters men may drink in safety. Let us then call nothing common or unclean which has for its end the health and welfare of the people, the purification of the people's water, and the fertilization of their land. Quite a legion of schemes have been advanced of recent years, with the professed object of the disposal of refuse or sewage, but in the great majority the material is treated as merely something to be got rid of or removed as quickly as possible, and little or no consideration is given to its disposal in the wider and more economic sense of the word.

Thus, with few exceptions, all the methods referred to start on the same principle of carriage by water, attended, as a matter of course, with the usual deluge of sewage. It is not, therefore, surprising that we should find them mainly composed of appliances for

reversing the original process, or, to speak more definitely, decomposing and separating the ingredients as far as possible, and, after some approach to purification, restoring each to its proper sphere.

The particular systems, of course, vary largely according to the conditions obtaining in each case; but wherever water-carriage is employed for conveyance, the subsequent treatment amounts to little more than an effort to undo what has just been done, and so recover, as far as may be practicable, the *status quo ante*, the deluge.

In this process, however, lies the crux of the whole problem. From the scientists' point of view it is not without interest, and, where the main conditions are under perfect control, it is probably within the range of practical achievement; but in the sphere of actual operation it is a very different matter. Here it is the unexpected that so often happens, and contingencies frequently occur to disturb the adjustment or balance of forces requisite for success. At one time it may be that the volume of sewage delivered at the works has exceeded the capacity of the beds, and the inrush has not permitted of the regular course of treatment; at another, it may be that the chemicals which have been added at different stages in its course have affected the bacterial appetite, or possibly destroyed altogether the organisms upon which the success of the whole system depends. Again, it may well be that the compound is of such a complex and disgusting nature as to defy any single method of disintegration and purifying treatment. We find, also, that the risks attending the pollution of water have not been greatly diminished by its means, while those arising from the pollution of air have been certainly increased. No further evidence of this is needed than the computation that in London alone there are about 2,000

miles of sewers being ventilated into the atmosphere we breathe, at a level just above the upper windows of our houses. With a fairly good current of air in circulation and an average amount of sunshine, the germs are distributed, and probably dry up in a very short time; but in the damp, foggy weather, so often prevalent in cities, with little or no wind stirring, this sewer gas would descend, with the well-known effect on the normal standard of health.

Dr. Vivian Poore, M.D., in his remarkably interesting work on "Rural Hygiene," says:—"Sanitation is a purely agricultural and biological question; it is not an engineering question, and it is not a chemical question, and the more of engineering and chemistry we apply to sanitation the more difficult the purifying agriculture. Our houses are flushed, but we pay for it by fouling every natural source of pure water, whether river or surface-well. If there come an outbreak of typhoid as often as not we find that the drains are to blame; but, as a matter of fact, we prescribe more drains as a remedy. We doubtless manufactured typhoid in a retail fashion in the old days, but with the invention of the watercloset we unconsciously embarked in the wholesale business." He also reminds us that four epidemics have occurred since its introduction about 1840. But lest this should be taken as the view of a theorist on sanitary reform, however eminent in other respects, I have taken a quotation from a leading article which appeared in the "Building News" of October 26th, 1895; and, although written ten years ago, it is practically just as applicable to present conditions as to the earlier period. Indeed, for a general indictment of the whole system of water-carriage, and as one coming, too, from a leading scientific journal, it would be difficult to surpass in force and clearness.

This is the passage:—"We have got rid of the visible filth, like that of the 18th century Edinburgh, but we have done it by establishing underfoot an all-pervading circulation of deadly gases which pollute the air at every street corner, and which, in spite of all precautions, continually find their way into our houses, and lay a foundation for all sorts of diseases. By expending millions upon millions of money we have turned the earth into a very hotbed for breeding typhoid, diphtheria, and many other pestilences, and then, as a further advance, we set up what is called 'sanitation,' which is mainly an attempt to save us from the fruits of our devices. We have cleaned the outside of the cup and the platter, but have made the inside so foul that it imperils our very lives to touch it. In towns our sewer system poisons the whole atmosphere. True, its vapours are diluted. We do not smell gaseous sewage in every breath we draw, any more than we taste liquid sewage in every drop we drink; but there it is all the same. And we meet with it in a concentrated and unmistakable form dozens of times every day—sometimes at home, always abroad. Wherever a foot passenger has to wait at a crossing, there, by the wisdom with which we are governed, he finds a sewer grating to envelop him with reeking stench. Wherever there is a crack or a cranny in the pipes of his house, the same disgusting odour issues out and assails him. If he is a tenant he is in frequent misery through the necessity for removing stoppages and doing repairs; and if he is a landlord, half his income is thrown away in paying for them. And if, in either case, he complains, he is threatened with being called an enemy to progress. For this belief in progress, to its votaries, is a religion, and religions have to be taken as they stand, and swallowed whole. It is not permitted to pick and choose, to take this part and reject that. If, therefore,

you would not be counted a heretic, and treated as one, you must stop your nose to sewer gas. You must glorify the advance of 'sanitation,' and be sure not to hint that nine-tenths of it would never have been needed if progress had only devised a *reasonable*, instead of an *unreasonable*, way of getting rid of domestic refuse; if, in short, it had all been *real* progress, and not two-fifths improvement and three-fifths sheer fudge."

It will be admitted that as a summary of results, after labour and expenditure extending over half a century, this article is not precisely encouraging: moreover, it would be no easy matter to disprove the charges conveyed in it. But again, supposing we are not all inclined to take the graphic statements of journalism too seriously, and would prefer to keep in the domains of exact science, it may be well to recall what Dr. Reid has to say on the question in his standard work on Practical Sanitation.

Thus on page 98 we find the following words: "All the new systems of sewage disposal which are brought out are presented to the public in glowing colours, and if only one-half of what is said in their favour proved to be correct when they were put on their practical trial, the question of sewage disposal need no longer trouble sanitary authorities." But so far from this being the case at the present time, it would probably be nearer the truth to say that the trouble only continued in an aggravated form, and at a meeting held at the Surveyors' Institute, on January 26th, 1903, the President is reported to have said that "with regard to the question of purification of our water supplies, and the profitable use of our waste sewage material, *he did not know that anything like a solution had yet been arrived at.*" So we may take it from this pronouncement that the much vaunted bacterial system has not revealed the secret of our quest: the great Sanitary Sphinx is silent still.

It is surely remarkable, nevertheless, that a century distinguished for its achievements in almost every other branch of science should have made so little *real* advance in this all-important field. The fact can hardly be attributed to lack of effort or energy, as the formidable array of new inventions abundantly testify. Not only have all the old types and patterns been changed for new—like the lamps in the Oriental fairy tale—but in the introduction of the bacterial system we have what is regarded as a radical change of treatment; yet the nett result of this, too, is practically nil. Even should we be inclined to credit it with bringing us a trifle nearer the methods of nature in the process of purification, it certainly leaves us no nearer the economic solution of the problem. This, be it remembered, is the *profitable* use of our waste sewage material: whereas not only is the effluent from these beds of very doubtful purity, but the actual product, instead of being a valuable asset, is simply a minus quantity.

We are, therefore, left to conclude that our labour has chiefly served to minimise and counteract the evil effects of a false principle, rather than to indicate any real advance on a true one. In other fields of discovery, our chief aim is to harness the forces of nature by co-operation with natural laws that govern the problem; and the system which appears most favourable to their action is reasonably accounted the most scientific and the best; but in the case of water-carried refuse this method appears to be reversed. What we insist on is the point of rapid disposal, no matter how temporary or full of risk the after consequences may be. And if we venture to raise a whisper that such a principle is opposed to all natural law and science, it is only to be dubbed a sentimentalist or, probably, a crank.

As a matter of fact, however, water resembles many

other of the good things of this life in being open to use or abuse in the purpose it is made to serve, and though one might be legitimate enough connected with the conveyance of merchandise, another would be a monstrous abuse when applied to the carriage of sewage.

The facility with which water can be laid on and adapted to serve our exacting modern demands has, indeed, betrayed us into burdening it with a task it was never intended to fulfil; a task which invests the element we are using with the weapons of disease and death before starting it on a dance through our midst, and then, forsooth, we affect a tone of injured surprise at the natural use to which the weapons have been put, and the prompt arrival of the epidemic. But the evil does not end here. The enormous waste that this system implies means little less than agricultural bankruptcy. There is an old saying among farmers that "Muck is the mother of money," and few deserve more heed at our hands.

Formerly, we might rely in great measure on our horses and on Guano importation to make up in some measure the existing deficiency in manurial agents; but at the present time the genuine Guano is becoming more and more adulterated and difficult to procure, while our horses are fast being superseded by motor or steam power. Thus, one by one, we are losing opportunities of returning to the land the fertilizing materials which we draw from it in the shape of produce. There is the usual debit and credit account to confront us at the end of the year, and if one does not balance the other, the result must follow that we become more and more dependent upon other countries for our supplies; and our necessity is naturally their opportunity.

Of all living things, man is the only one who can give the fullest scope to the productive forces of nature; and

we can no more afford to waste our fertilizing refuse than we can afford to throw away any other source of wealth or vital energy. Sir William Crooks, in his book on the "Wheat Problem," states that some £16,000,000 worth of fixed nitrogen was annually lost to agriculture by the reckless discharge of sewage into our rivers and sea; but in our superior enlightenment this is precisely the course we have adopted; a course which, in the words of Mr. Rathbone, is aptly described as "making a sewer of the sea, and a desert of the dry land." Comparing the estimates, however, from many reliable sources, we should probably be well within the mark if we put the yearly loss on the waste for the United Kingdom at £20,000,000. About the same sum is then spent by the Agricultural world in Guano and Nitrates from foreign countries to replace that which has thus been sent into the sea. Yet a further sum of £20,000,000 is spent in being compelled to effect this waste according to elaborate bye-laws. To put down another £10,000,000 or so for doctors' bills, which we must pay to save us from the consequences of our own initial mistake, would, of course, be regarded as the vapouring of a mere fanatic; but, at the same time, there might be more foundation for even such a statement than many would be inclined to admit. It is somewhat difficult, however, to give a definite formula whereby we may arrive at the correct value of the human excreta as a manurial agent, as there is apparently a wide difference between the commercial value of the chemical ingredients and the actual value that the closet earth realises in many of the large manufacturing towns where the earth system is largely in operation.

The three essential manurial elements of the human excreta are nitrogen, potash, and phosphorous. The other constituents may be disregarded for the present

purpose, and the money value has been variously estimated at anything between 5/- and 15/- per head per annum. The late Sir John Lawes estimated the total at 8/10, while another authority (W. D. Halliburton, M.D., F.R.S., in his Handbook of Physiology), brings his gross total to 10/8½, Hofman and Witt, 11/9¼, and Sir William Crookes has adopted the round figure of 10/-, the latter estimate having become generally accepted as the recognised value of the chemical components. When this is compared, however, with the sum the closet earth is actually fetching, we find that in Manchester it commands a ready sale at £3 per ton in lots of 50 tons, and even up to £6 per ton for the manure retailed in small quantities; a price which would represent a much higher value than the 10/- above quoted.

It is true that this is accounted for in cases like Manchester and other corporations, in which the admixture of bone phosphates, etc., is regularly practised. This, however, naturally increases its value considerably, and therefore renders any calculation based on these results misleading if taken as a criterion of intrinsic values alone.

But notwithstanding the apparent discrepancy between the recognized chemical and the practical values of closet manure, there seems to be a fair consensus of opinion amongst those having actual experience that this estimate of 10/- per annum does not adequately represent its real value to the horticulturist, and we are therefore left to conclude that the excess is made up by the large proportion of organic matter and fertilized earth which the compound includes, not otherwise accounted for, and thus bringing the total to say 13/-

This figure, however, is of course more or less reduced by the cost of municipal collection, &c. Under

the present system of collecting the refuse in a semi-fluid condition, with air-tight pails, followed by the process of cleansing, disinfecting, and artificially drying the product, it is no wonder that these expenses assume a proportion of two-thirds the original value, but which, under a well-organized system of separation and dry collection, would at once be reduced to about 25%, or one quarter, instead of two-thirds, which would then bring the nett value back to about the original of 10/- The latter figure would then represent a total of about £20,000,000 per annum when multiplied by the number of the population of the United Kingdom. Moreover, we have it from no less an authority than Moore, in his Standard work on "Sanitary Engineering," that a dry manure of this kind finds a ready sale at Rochdale and other places (where an earth system has been more or less adopted) at the rate of £6 a ton. Thus, for instance, in a town, say, of 50,000 inhabitants, producing a total of about 30 tons per day, and putting the value at, say, £3 a ton (to keep well within the mark), it will be found to realize the respectable sum of £90 per day, or, in round figures, £32,000 per annum. This, however, represents the gross value, and deducting therefrom 25% for the cost of collection and working expenses, we obtain a balance of about £24,000 as profit available for the reduction of the rates, or if we prefer to base the calculation on the estimated 10/- per head per annum before referred to, we arrive at about the same figure, viz., £24,000.

The writer is indebted to Mr. James Ashton, F.C.S., Fel. Inst. San. Engineers, Manchester, for a copy of his paper on the "Collection and Utilization of Excreta in relation to Sewage Treatment," read before the Institute of Sanitary Engineers, 1902, in which the drawbacks attending the water-carriage system are stated very forcibly.

It is difficult to select when the choice is so large, but in referring to the cost of collection and treatment of sewage proper, he says that "if we put the first cost of supplying pure water to a town for flushing purposes (construction of waterworks, &c.) on an average of £50,000 per million gallons of storage capacity per twenty-four hours, we shall not be very far wrong. When we have spent this large sum of money on the collection of water for flushing purposes, we then get this volume at the sewage works, plus excremental solids which have there to be purified before the water can again enter a water-course. Now the first cost of a sewage purification plant to treat this volume of sewage, viz., one million gallons per twenty-four hours, is, on the average, about £30,000.

Putting the number of gallons of water to each person, for flushing purposes, at eight, which I consider is the very lowest limit that could possibly be used with effect, then a million gallons would serve a population of 125,000, and would involve them in a first capital outlay of £80,000. We shall see later on how this sum compares with the outlay of a conservancy system on modern principles.

We have seen the value of excreta as an agricultural manure, and we have also seen the improvidence of washing it out of existence by that valuable article, water, at a benefit to nobody, and at an expense to everyone."

It is true, of course, that so-called sewage farms are constantly established with the object of turning the sewage to a profitable use, and rendering the effluent sufficiently pure, to be discharged into the rivers and watercourses.

But the yearly crop of litigation and official reports on river pollution is a striking proof that this expedient is

little more than a pious intention deserving a better result. The attempts at restoration come too late: the character of the matter is changed by reason of the chemicals in the shape of waste products or precipitates which play an important part in the composition of it, and the sewage is thus rendered not only perfectly useless as a manure, but, what is more than probable, an active poison to plant life. But whether the effluent proceeds from a chemical or bacterial system, the Local Government Board are clearly not convinced as to its reliability or efficiency, as they still insist on their rule that the effluent should be applied to the land in the proportion of an acre to a 1,000 people in the population. It is also obvious that if the system had really the success which its promoters claim for it, recourse to the land would be unnecessary; on the other hand, if it be inefficient, it is difficult to justify the enormous expense of the intermediate treatment instead of adopting the simpler method of going to the land direct.

The real problem under consideration is the profitable use of our waste sewage material, and here is a system hailed with acclamation and received as a solution, whose express object would appear to be the cultivation of bacterial rather than of vegetable life—a system which, even at its best, often yields an effluent little removed from crude sewage. In the examination of the coke beds at Barking and Crossness, for the London County Council, this fact was fully confirmed, various species of bacilli being found in the slimy coverings of pieces of coke in the beds, and in a general way "little or no real distinction could be made out between the cultures made from the crude sewage and those made from the effluents." "This table also shows that the effluents from the Barking and Crossness precipitation

tanks are no better, if, indeed, they are not worse, than average samples of the raw sewage."

In the cases where the sewage is discharged into the sea the result is perhaps less obvious, though none the less deplorable and repellant: and in many fashionable seaside resorts people may be seen bathing within a quarter of a mile of a flock of gulls, which generally indicates the exact position of the outfall. They are probably happy in the assurance that a plentiful dilution has rendered the sewage harmless, although, as a matter of fact, typhoid and cholera germs have been traced with little difficulty 16 miles removed from the point of discharge.

In the Annual Report of the London County Council for 1905, we find that the DAILY quantity of crude sewage delivered at Barking and Crossness for treatment amounts to 245,188,449 gallons, representing the product of one city alone which dumps its sludge into the sea. We may fairly assume that wholesale pollution of this kind will not stop at oyster beds, river beds, or even ocean beds; its defiling presence is becoming universal, and its influence too subtle and far-reaching to admit of the limitations which men seek to impose on it in self defence, while the supply of pure water becomes daily more restricted and difficult.

It is thus that the sewage spectre haunts us at every turn. The objectionable matter is no sooner hurried out of sight in one place than it crops up in another, where the difficulties of final disposal are all greater than in the first instance.

Under these circumstances the natural and obvious question would appear to be: Is the creation of sewage in the first place to be accepted as a necessary and unavoidable evil? Or: Is it still within the limits of human ingenuity to produce a more rational method by

which this nuisance may be avoided, and a dry product substituted ?

"Custom hangs upon us, with a weight
Heavy as frost, and deep almost as life."

Still, the spirit of inventiveness is not dead ; indeed, we have only to look at its achievements in other directions to see that, on the contrary, it is really very much alive. But in attempting any departure from the beaten track we cannot do wrong in learning the lessons and profiting by the experiences of the past. Thus, on one side we see that the practice of fouling pure water with excremental matters is not only wasteful and unscientific, but full of risk and danger to public health and life. In addition to this, the evidence of scientists is overwhelmingly in support of the assertion that earth is the only natural destiny and effectual absorbent of all organic refuse.

It is clearly to this principle, then, or to some modifications of it, that we must look for deliverance, although the bare mention of earth in this connection is probably sufficient to lay oneself open to ridicule as a reactionary, if not to evoke the suspicion that the author must have just emerged from the ark.

I shall not, however, admit the soft impeachment ; on the contrary, I shall have the temerity to propound the question which the foregoing facts obviously suggest :—

Has not the time arrived for a serious effort towards the fuller development of the dry principle as a whole ? a development, that is to say, which would bring it into line with its more formidable rival ; which would be not only in keeping with the highest scientific thought on the subject, but would be equally adaptable to modern requirements and conditions.

The Sanitary Engineer will tell us that, although the dry earth or conservancy principle may be sound in theory, and can even be applied with advantage to dwellings

forming isolated cases, or to small villages and in low-lying districts, it is not practicable generally, and that the convenience and cleanliness attaching to water-carriage far more than outweigh the disadvantages which unavoidably attend its adoption. He will also tell us that as a mixture of solids and fluids is practically inevitable in the cases of surface and road drainage, it is better to retain the same method throughout, to avoid unnecessary complications; he will affirm (and what is more important still) the published statistics giving the comparative rates of mortality of the various towns confirm the popular practice, and show that those that are fitted with water-closets and the modern system of drainage are more favourable to health than those fitted with earth-closets, supplemented with a system of collection.

Stated in this way, the case for water-carriage is apparently a strong one; but in the first place, it must not be forgotten that statistics have not the highest reputation for veracity. To begin with, the calculations are based on a shifting population, and if, therefore, a larger number leave those towns and centres to die elsewhere than that coming from the other districts to die within them, the statistics which are built up on such data become practically worthless. It will be seen that a close examination of the relative conditions is always necessary before much reliance can be placed upon them; in the second, the dry-earth system, with its imperfect method of mixing both fluid and solid refuse indiscriminately in one receptacle, is fatal to the dry principle at the outset, and, in point of fact, courts the actual process of putrefaction which should be its first and paramount object to avoid.

While this, however, constitutes a fault in a system otherwise sound, the evils attending water-carriage are inherent in the principle itself, and are almost impossible to retrieve. Dr. Vivian Poore says that "no amount

of dilution is capable of destroying a zymotic poison, and it is not impossible that the mere mixing of organic refuse, which contains a zymotic poison, with water, may be the means of keeping it alive, and possibly causing it to multiply."

The life, however, of these organisms would probably follow the general law, and last just as long as the septic condition of the water provided them with sufficient food to sustain their existence.

As the initial error, therefore, consists in the mixing of putrescible matters with water, so the remedy naturally lies in the direction of separation.

Science has taught us that the upper layers of the soil are teeming with forms of organic life whose hunger is inexhaustible, and whose power of absorption is so active that anything that is even thrown on the surface of the ground speedily disappears, and, whether animal or vegetable, becomes humified and so incorporated with the soil as to become actually indistinguishable from it.

Prince Krapotkin, in that invaluable book of his, entitled "Fields, Factories, and Workshops," reminds us "that agriculture in this country has fallen into neglect, and that our land is going out of cultivation at a perilous rate." He also makes some striking comparisons of what is being done here, and what they are able to accomplish in France, Holland, and Belgium, under a proper system of fertilization. Again he speaks of "the fraud and adulteration which are exercised on such an immense scale in the manufacture of artificial manure"; and yet again confirms Dr. Poore in asserting that "the manufacture of manure is considered as a chemical process, while it ought to be considered as a physiological one."

From the latter the land draws its supply of food as well as warmth, whereas the former chemical manures

are often little more than "a pompously labelled and unworthy drug," as uncertain in its action on the crop as it is in many cases injurious to it.

Dr. Alfred Russel Wallace, D.C.L., F.R.S., says: "I have always been of opinion that the present system is wrong and bad, both from its waste and its dangers."

Speaking of the earth system in connection with sanatoria and open-air treatment, Dr. Charles Reinhardt says: "That the earth-closet system is to be preferred to even the best method of water-carriage, and, with care, it is found quite satisfactory even for indoor closets."

Dr. G. Reid, M.D., in his work on "Practical Sanitation" (3rd edition, 1895, page 73) says: "The great principle, then, to keep in view is the immediate and thorough removal of all fluid refuse and the retarding of decomposition in all solid refuse until it can be completely removed . . . . .

"*Dry* fæcal matter, comparitively speaking, does not decompose rapidly; but when mixed with water, or, what is worse, urine, the change almost immediately takes place . . . . ."

All this testimony seems to point to one conclusion, viz., that in dealing with house refuse natural affinities must not be disregarded, nor dissimilar things mixed. In other words, that the principle of separation should be established as far as possible, in permitting the liquids only to enter the drain, while treating the fæces with dry earth, or some carbon equivalent, as its natural medium and disinfectant.

It is true, of course, that storm and surface water bring a certain amount of solid matter into the sewers, but surely it is not because we cannot prevent some solid matter from entering the surface water drains that we should multiply the difficulties indefinitely by sending

as much down as possible. The engineer of the present day, when dealing with sewage, appears satisfied to shelter himself behind the old proverb: "One may as well be hung for a sheep as a lamb," and we are left to accept the inference that "if you are going to make a mess, it is just as well to make a big one." But on the other hand, supposing we could once succeed in stopping all organic refuse from entering the drains except what was purely unavoidable, the volume of water required for flushing purposes would at once be immensely reduced, the element which is the chief cause of trouble would be eliminated, and the subsequent process of filtration rendered comparatively easy and harmless.

The improvement which might be expected from this source is clearly exemplified by a series of careful experiments carried out by a Special Committee of the Sanitary Institute to ascertain the quantity of water required to flush the watercloset, etc., and these experiments, as noted by Dr. G. V. Poore, give some very interesting results. Thus, in a 4in. drain, 50ft. long, and with a gradient of 1 in 40, it was found that with a flush of two gallons 5 per cent. of the material used remained in the closet-trap, 27 per cent. stuck in the drain, 37 per cent. lodged in the disconnecting trap, and 31 per cent. "cleared." With a flush of three gallons 1 per cent. remained in the closet-trap, 1 per cent. in the drain, 25 per cent. lodged in the disconnecting trap, and 73 per cent. cleared. It is interesting to note that under no conditions tried in these experiments was the closet-trap completely cleared of excrement; and that with a drain of 50ft. long in no case did less than 25 per cent. of the excrement lodge in the disconnecting trap.

"When it is remembered that a trap is a device for producing a local stagnation, and that a trap filled with excrement or urine or soapsuds inevitably becomes foul;

and when it is further remembered that the stagnant mixtures of fæces and water are typical 'cultivating chambers' for such microbes as grow in water, be they pathogenic or otherwise, it will be conceded that traps of all kinds are very undesirable adjuncts to the dwelling, and must be regarded as necessary evils for mitigating the dangers of a faulty system."

In these days of "advanced" sanitary science it is the fashion to look at the dry system as belonging to a retrograde movement, notwithstanding the fact that water-carriage, which is the essential feature of this so-called advance, is universally admitted to be wrong, and deprecated by the first scientists of the day. The anomaly, however, is not so difficult to explain, nor even to justify, in view of the facilities that water affords for rapid disposal under the crowded conditions of town or city life; nevertheless, it should be borne in mind that this system is in the nature of an expedient, to be avoided wherever possible, and that its success necessarily entails an enormous waste at a ruinous cost, while the dangers attending the reckless and wholesale pollution of water constitute one of the most pressing evils with which it is possible to threaten mankind. Indeed, we might fairly say that the more perfectly the water system is applied, the greater the danger which must eventually arise from it.

It is in view of these evils that the advantages of the dry system become more apparent, because the indictment outlined in the foregoing pages is true of the water-carriage system in its modern and most approved form, whereas the disadvantages attending the dry system adhere chiefly to its crude and most primitive forms; and it follows naturally that the more it is improved as time advances, the less would be the inconvenience entailed. In either case, however, the principle does not admit of

any compromise; each system must be drastic and thorough in its own way, or results follow which are experienced in many of the so-called waterclosets abroad, and earthclosets at home, where the receiver in either case holds a compound which is neither fluid enough to travel nor dry enough to crumble, and the process of disposal is rendered as difficult as it is offensive to accomplish. In fact, it cannot be too plainly stated that the smell which generally arises from the ordinary form of earthcloset is practically in proportion to the amount of liquid which is allowed to collect in the receptacle provided; thus it will be found to subside when additional earth (or other deodorant) is added, and practically to disappear entirely as a dry condition is reached.

. Hitherto the chief objections to the use of the dry earth system for closets arise either from a faulty application of the principle, or in not carrying it far enough to ensure its complete operation. Not very long ago the same thing might have been said in respect to the old, and now obsolete, methods connected with water-carriage, and both cases tend to show that whichever medium is adopted, the system must be carried through scientifically and completely in order to obtain satisfactory results. Thus, to speak more definitely, earthclosets which allow the excreta to become mixed with solids and liquids collected in one receptacle, certainly compromise, if they do not actually destroy, the main feature of the dry system, because the liquids being always in excess of the solids, render the process of absorption practically impossible, and put cleanliness out of the question. Primarily, it cannot be questioned that nature clearly teaches separation, the urine being separately secreted as well as voided, and the main object of a closet of this kind should be to provide the means for

Plate 1.

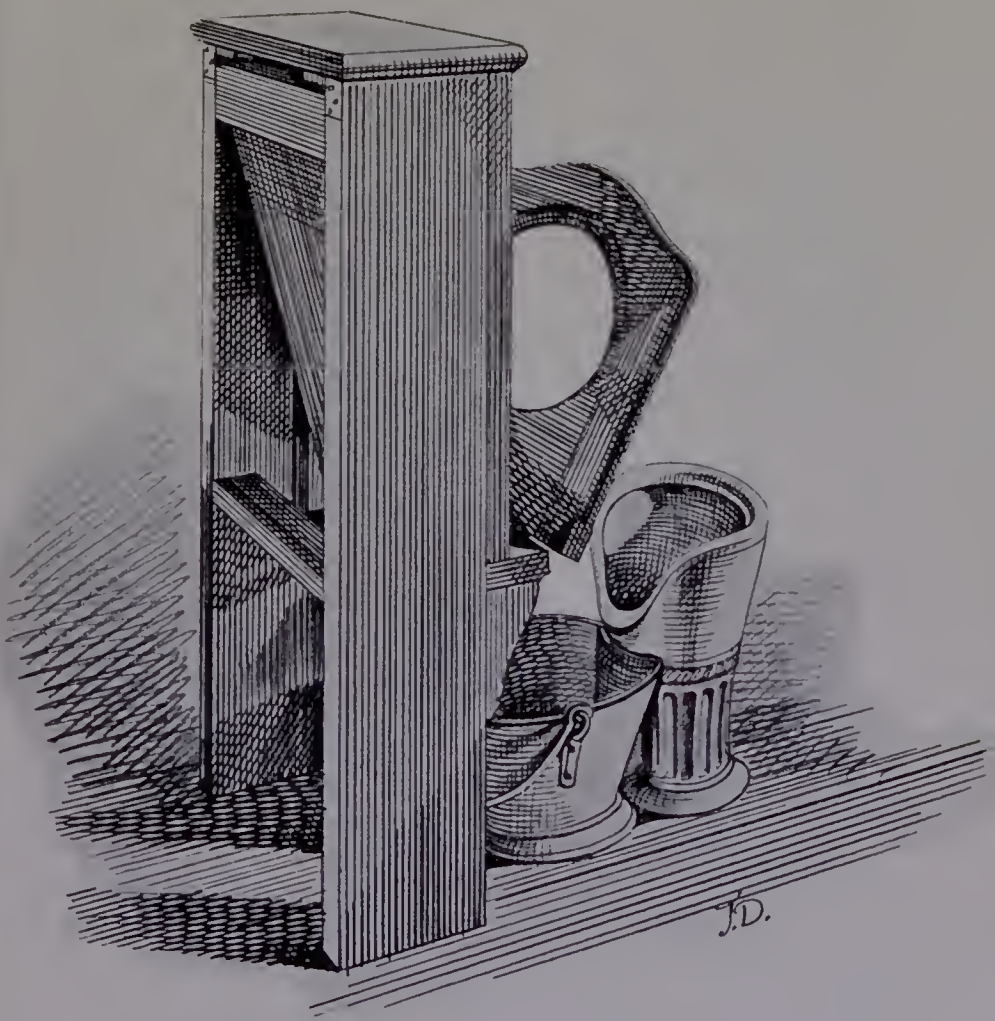

PLATE 2.

assisting and completing this principle in its entirety, and where this is done it will be found that most of the objections to which the dry system has been open to in the past will disappear.

Clearly, therefore, it is essential that an earthcloset should be constructed in such a way as to keep the dry principle, as far as possible, intact, not merely in the perfunctory use of earth, or any other dry agent adopted, but by at once taking advantage of the natural impulses of the body, and perfecting the separation which nature commences. This, however, can only be attained by providing a dual container, or separate receptacles, so that any mixing of putrescible matter with water or urine is avoided, and each is rendered harmless by the dry and separate treatment which the problem requires.

In order to render the details of this principle more easy to follow than would be possible by closer verbal description, several illustrations are given which fully indicate the various parts of the scheme, and thus show the practical means which the author has adopted with increasing success to obtain the objects in view, viz.: Separation; Evaporation of the Urine; Dry and portable products; No offensive smells, and Full manurial value.

By referring to Plates 1 and 2 then it will be seen that a vessel is placed in front for the exclusive reception of the fluid matter, while a separate container is provided behind to receive the solid excreta and the earth, the latter being supplied from a hopper at the back of the seat, and regulated by a shute valve of simple construction, which, by a single action, both delivers and distributes the earth simultaneously.

When a closet is arranged in this way, the question of separation offers no difficulty whatever in the case of either sex. It is absolutely automatic and certain in

action, and by no possibility, with fair usage, can the liquids enter the bucket, or the solids touch the pedestal. Hence, the soil receptacle is always in a dry condition, in which the natural process of humification is most active, and the operation of removal or distribution most easily performed.

It will be seen that this method presents a wide contrast to the earlier system now in use, in which both forms of excreta are collected in the same bucket, generally resulting in an offensive and dangerous slop emitting even worse gases than the sewer, and compelling the necessity for air-tight covers, with arrangements for special cleansing and disinfection before re-use is possible. By the plan of separation before referred to, the contents leave the bucket practically clean, and without the least smell or offence in any way. The treatment of the urine is then on much the same principle as the soil. In the case of a simple garden-closet it may be conducted to the earth direct, if the other conditions are suitable, or conveyed by open channels charged with sawdust or other deodorant, by which it will be readily absorbed or distributed.

It may also be treated by evaporation, as in Plates 3 and 4. In this case the floor of the closet may be raised a step, and the urine allowed to fall into a porous trough in a ventilated space underneath, which is supplied with some such material as earth, peat, sawdust, fine coke, or carbon. Naturally, the larger the surface exposed to the air, the sooner evaporation will ensue. Peat or sawdust has been found to absorb about eight times its own weight in urine, while the capacity of the other agents will vary from one to four times their own weight, and when the conditions are arranged as described, the evaporation will go on automatically and for an indefinite length of time. The process may be explained by the fact that the salts

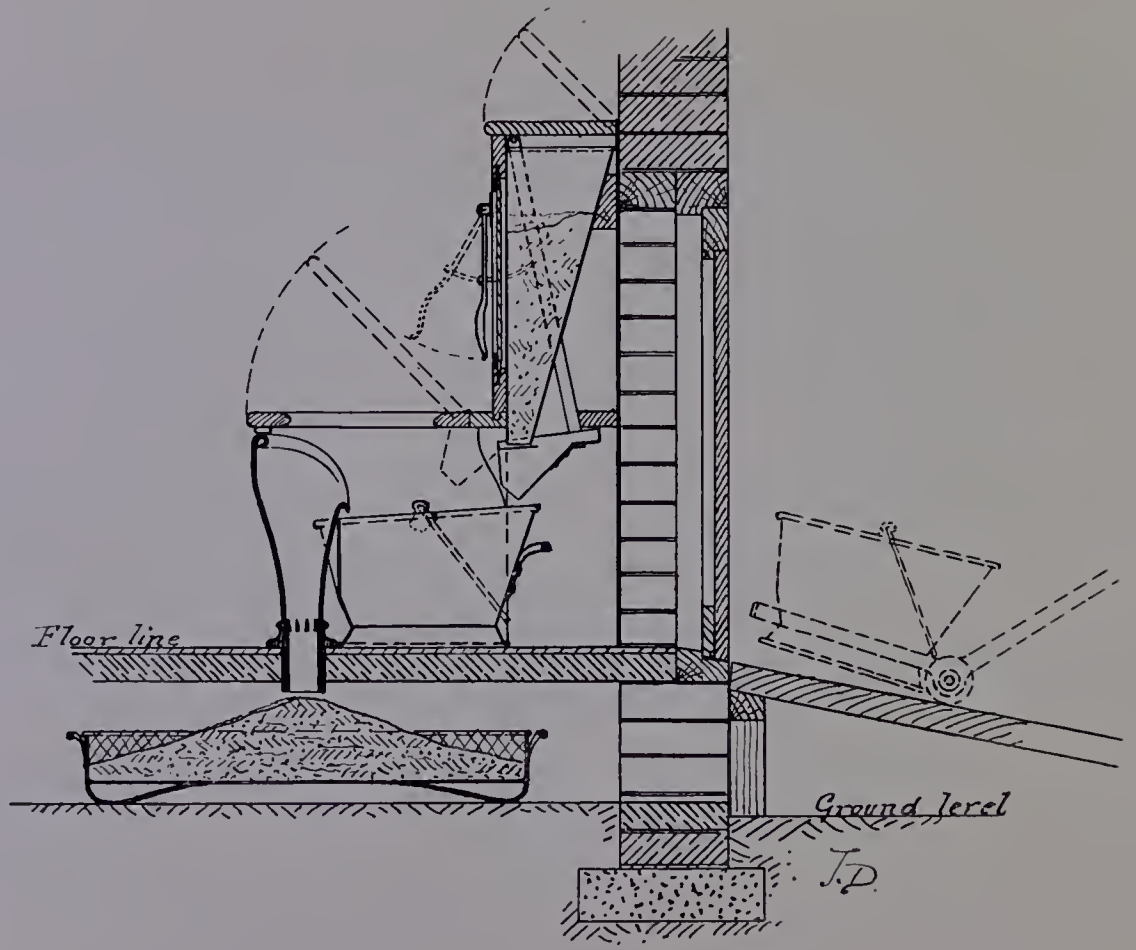

PLATE 3.

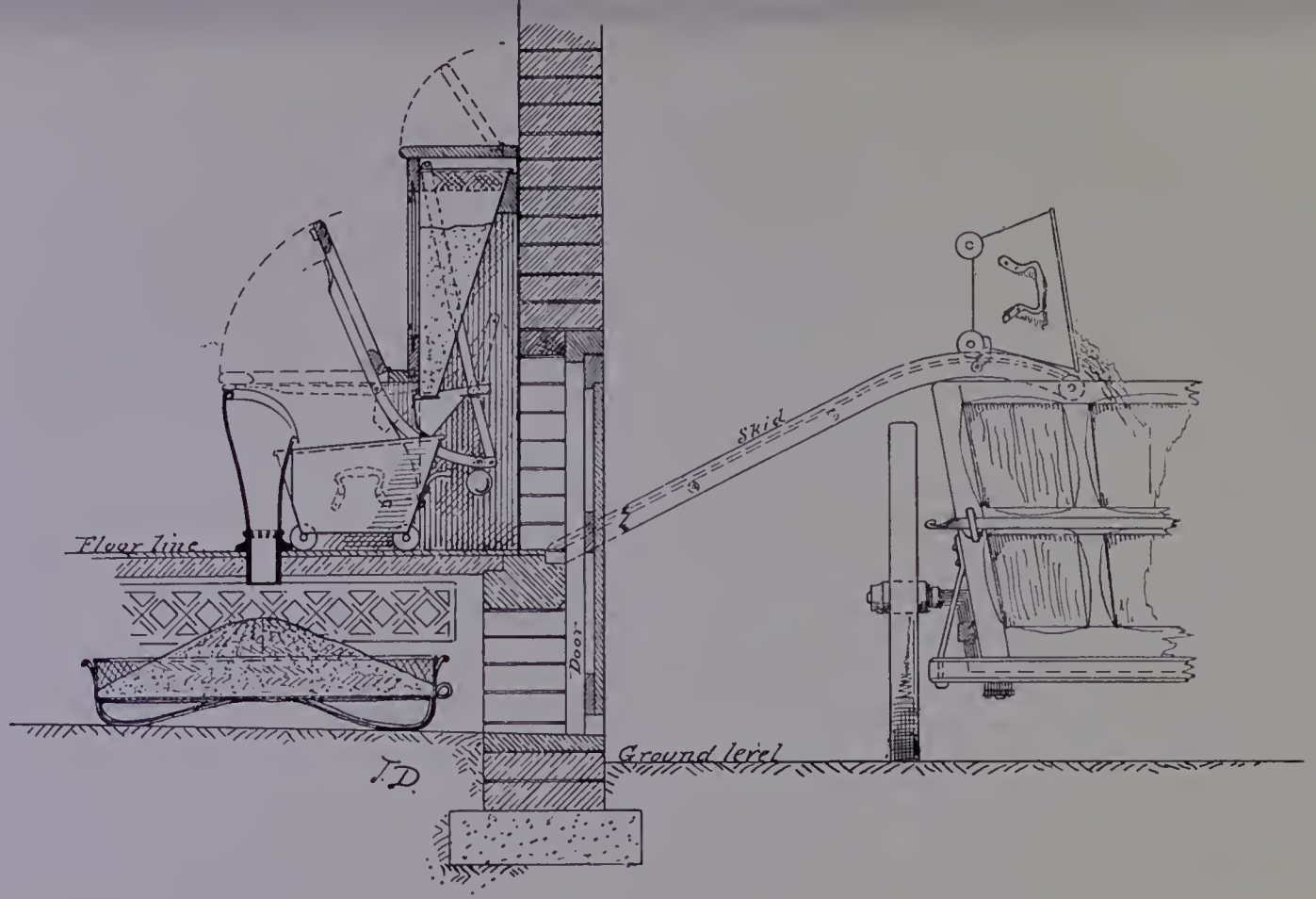

PLATE 4.

and solids held in suspension, which emit such disagreeable odours when evaporating under ordinary circumstances, undergo nitrifaction when brought into contact with earth or any of the substances named, with the result that the solids are left behind in the earth, and the water alone is given off in the form of vapour, without any offensive odours whatever. No chemical antiseptic or deodorant is necessary to obtain this result, the only essentials being that the agent or medium used should be of a loose and absorbent nature, and the more air that is admitted the better the result. The rate at which evaporation actually takes place will naturally depend upon the quantity of urine admitted in relation to the evaporating surface exposed, and the climatic conditions prevailing; but the principle admits of application on any convenient scale. It would, however, be a comparatively simple matter to arrange the various parts so that the provision for evaporation shall at least balance or preferably exceed the amount of fluid likely to be admitted. But even if the in-take should by chance exceed the absorbing capacity of the bed provided, no further trouble need be anticipated than that the surplus or filtrate would run into the surrounding earth as a comparatively pure and colourless water. At intervals of one to three months, or even more, it might be felt desirable to change or use the earth in the contact bed or evaporator; but as it assumes a form scarcely to be distinguished from the ordinary garden mould, the removal presents none of the usual difficulties and risks attending the mixed systems, and the product is always of the highest commercial value as a fertilizer.

Plate No. 7 is intended to show a somewhat similar arrangement adapted to indoor closets and for upper floors.

In this form of closet two shafts are employed : one to convey the earth or dry agent from the earth reserve at the top of the house down to the several hoppers belonging to each closet on the floors below ; the other (a cast-iron shaft with an enamelled lining) to convey the soil down to a truck or container in a lower chamber.

It will be seen that the earth reserve at the top can be filled from the outside by means of the pulley arrangement indicated, and the truck or tank at the bottom may be also removed or emptied from the outside, so that both the supply and waste go on much in the same way as when arranged for water, without interfering with the internal arrangements of the household, and without any risk from sewer gas or burst pipes, often attending the water-carriage system.

The general principle of separation is secured by the pedestal being a divided one, the back portion being fitted with a hinged pan, which at the same time forms a seal to stop draught, somewhat similar to a valve watercloset. This pan, on the handle being raised, discharges the fæces and earth into the vertical iron soil-pipe before mentioned, while the front portion of the pedestal, taking the fluids, is provided with a flushing rim and trap connected with a pipe leading either to the drains, or treated by means of aerobic beds and evaporation on any required scale.

In these closets the rising seat is made to actuate the supply of earth to the pan automatically before and after use, while the action of pulling up the handle in the ordinary way discharges the contents of the pan and flushes the pedestal.

By this method it will be seen that, although the drains (which in the isolated closets are in no way essential) are brought into use, the waste water or sewage is deprived of just those ingredients which are the cause

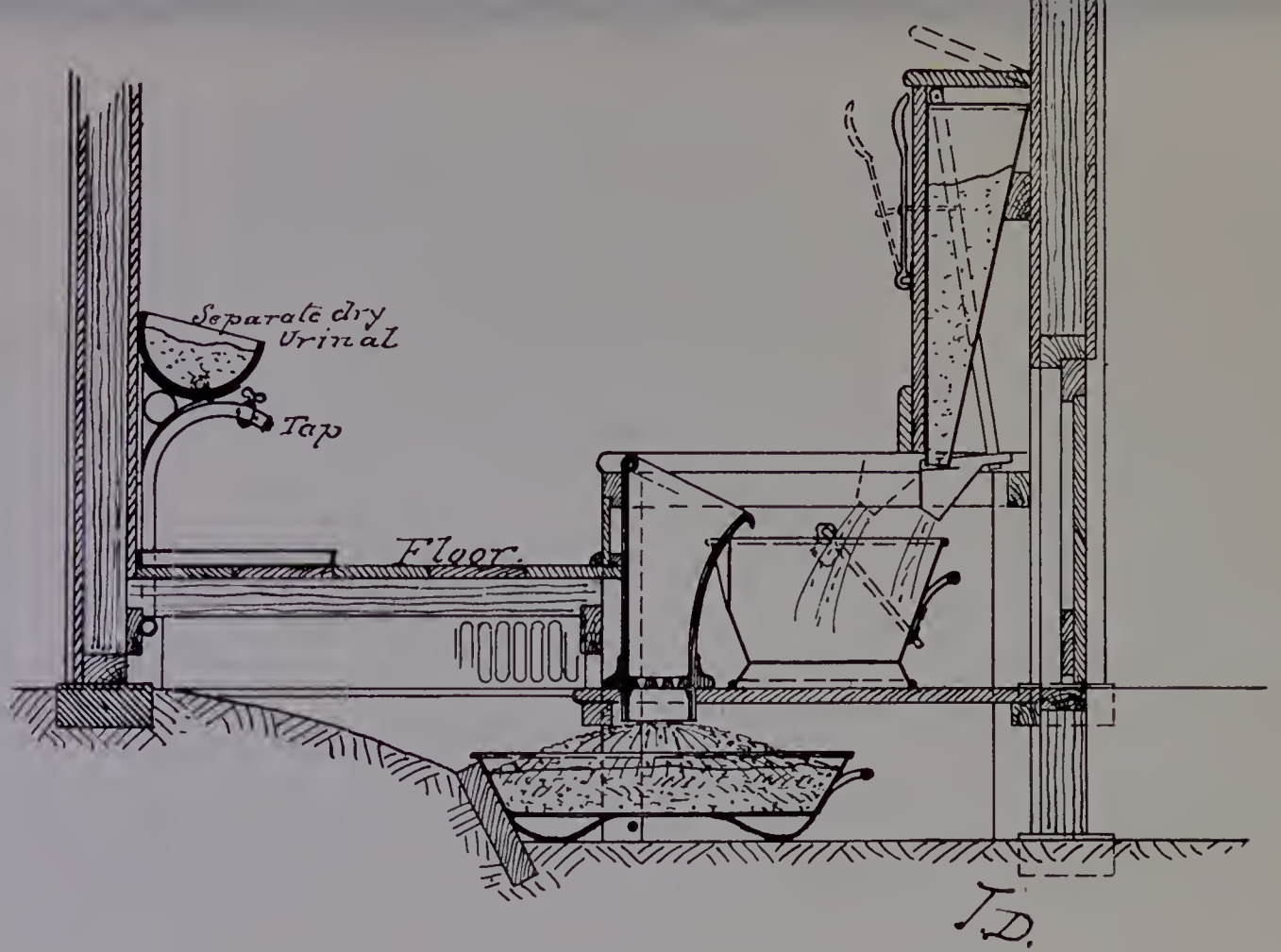

Plate 5.

of so much trouble in the contact beds by clogging up the pores of the earth, coke, or other medium, and hereby checking the natural filtration and evaporation.

In an Essay, which obtained the Belilios prize, entitled "The System of Drainage and Sewerage best suited to Tropical Climates," Major F. Smith, D.S.O., has given us the result of a wide personal experience of various systems in an able and practical manner; and on page 21 we read that "the dry-earth system has long been regarded by Anglo-Indians as the ideal plan," and "when due care has been exercised in carrying it out, odour is reduced to a minimum, excreta are removed daily, and there is nothing to get out of order;" but "for the ordinary run of people, and natives particularly, it is not sufficiently automatic." Further on, under the heading of "Tanks and Effluents," he says: "The most important fact in connection with these fashionable sanitary inventions is that none of them have been shown to render the final effluent so free from pathogenic bacilli that it could be safely run into drinking water. It is not clear, therefore, that we are any better off than before;" also that "the cesspit may be looked upon as a septic tank, and, conversely, we may regard the septic tank as a glorified cesspool," and although "the cesspool is vaguely said to poison the air, so do sewer ventilators even more."

On plate 5 it will be seen is an illustration of a dry closet on the separating principle, but at the same time adapted to native customs, with a view to meeting some of the difficulties enumerated by Major Smith. The principle being much, however, the same as in those already described, it is scarcely necessary to enlarge on the details, which are sufficiently clear on the drawing. It is only, perhaps, needful to say that the top, which in the ordinary way forms a seat, is here adapted for

standing to suit native customs, while the space under the floor becomes a ventilating shaft right through for assisting evaporation in the trough, or earth below, receiving the fluids. Then on the handle being pulled as indicated, the earth is promptly discharged, and the shute returns to its normal position by a weight or spring.

From the opponents of the dry system generally it would be natural to expect that the strongest opposition would centre round the difficulty connected with the supply and collection of the earth, more especially in those cases where no available ground or curtilage is attached to the house to provide directly the necessary medium. It is, of course, freely admitted that in this one respect the water system has the advantage, though such advantage is more than counterbalanced by the drawbacks adhering to it at later stages. It must also be borne in mind that many of the difficulties which the dry system presents are largely due to the prejudices which surround any change of custom, rather than to any real or essential difficulty in the system itself. In support of this contention we need only refer to countries such as Norway, Sweden, Denmark, Belgium, and Holland, in which it has been largely adopted, and where the difficulties before alluded to are not, I believe, seriously felt. It must also be borne in mind that a regular system of house-to-house collection for dust and other refuse (the latter frequently very decomposed) is already established in towns nearer home; and if the earth from the closets were added to it the odour would become absorbed, while the manurial value would be greatly increased. A corresponding addition in the work of removal would, of course, accrue; but this at most would only be a question relating to bulk, which would be amply atoned for by the advantage of a dry condition At the same time, it must be frankly admitted that (after

making all allowance for improved methods of removal, including the condition of the refuse removed) the chief and paramount obstacle to the general extension of the earth system has always been found in the slow and cumbrous process of the pail collection. Whatever form this may take, it is to be feared that no considerable advance along these lines is probable until the objection here stated has been overcome, and a way found for something more expeditious and more in accordance with modern requirements and ideas.

No such difficulty, of course, presents itself in the country, or where a sufficient amount of garden is attached to the house; but in respect to town houses, where no such advantages are available, the writer is of opinion that a system of dry containers, emptied by a portable pneumatic apparatus, will probably take an important place in the sanitation of the near future. In the first place, the principle has already been tried, and is achieving success in many different directions. For instance, there is the ordinary exhaust pump, now extensively in use for emptying cesspools. There is also a further development of this method (lately devised by Captain Liernur, a military engineer of Holland), whose system is now working at Stanstead in Essex, and, indeed, promises to be a marked success. Like its forerunner, its initial principle lies in the suction of the material deposited in the separate receptacles attached to each house from these original receivers into a larger or more central public reservoir. This reservoir, being exhausted of its air, the accumulations are drawn towards it by means of pneumatic pressure, the operation being repeated at convenient stages, until a main depôt is reached, where it is disposed of according to public requirements, or as may be most convenient for agricultural use. Again, in the vacuum cleaner, we have

another illustration of the means whereby dust and fine refuse is extracted in a dry condition by the same motive power; and providing that the engine and exhaust are sufficiently powerful, there would seem to be little real difficulty in so extending and adapting this system as to enable it to deal with dry closet-earth in a somewhat similar way, but the operation of applying the vacuum pump and withdrawing the contents of the house-containers would be quite independent of the occupants, and would certainly be far more expeditious than any method of hand removal. The liquids would be taken down separately to a dry contact bed or evaporator in any convenient position, and the whole system rendered practically as automatic as a watercloset without its drawbacks. There is a general impression that excremental matter would soon clog, and eventually stop up a dry soil-pipe of this kind, whether in a vertical or horizontal position. This, however, is not borne out by the writer's experience. On one occasion he had a dry closet and a section of cast-iron soil-pipe with enamelled lining fitted up for the use of twenty or thirty men who were engaged on a building he was erecting, and when it was taken down, on the completion of the work (about four months afterwards), he found little or nothing adhering to the sides, which were, in some cases, as bright and clean as on the day it was put up. But if, occasionally, a little matter did happen to adhere, it would soon dry in the ventilated pipe; and the glazed lining not admitting of any suction, the next charge of dry earth passing rapidly down the pipe would naturally remove any slight obstacle in the passage, leaving the surface quite clear, and even bright.

Plate 3 shows a method by which the bucket is removed by a trolley somewhat similar to a barrow with

handles, when it can be wheeled on to the ground direct or removed in any other convenient way.

Another method is shown on plate 4 by which the space between the bucket and the cart is bridged over by a skid with grooved sides, and the bucket, being mounted on wheels, can be easily run up or down the skid, the contents tipped into the cart as indicated, and the bucket replaced. The soil from these closets may be dug in at once, or stacked for a few weeks, and allowed to humify, or even reused three or four times if sufficient interval is allowed between for the natural amalgamation to take place—and this without any appreciable deterioration of its absorbent power or disagreeable smell arising from it.

To ensure the proper action of all earth or dry closets, however, it is important that the earth, ash, or other agent should be properly sifted and fairly dry. The former process can be readily accomplished by an ordinary sieve of not less than four meshes to the inch; and no artificial heat is required for the latter.

Such then is the general outline of the various means the writer proposes towards the advancement of the principle of Dry sanitation, and though it would not be within the scope of these pages to enter into a fuller description of details, or to review contemporary appliances of a similar character, no words on this subject would be complete without a generous recognition of the pioneer work which was achieved by the Rev. Henry Moule, in the early stages of the movement, to whom we may be said to owe the initiation of this system.

That the method which the author proposes will probably leave ample room for improvement goes without saying, while it is equally unnecessary to say that any description or treatment of the subject within so limited a space must necessarily appear more or less

superficial to a technical mind; but in view of the widespread depression which has existed in the agricultural industry of this country for many years past, it is at least an effort to check the criminal waste of the prevailing system, and to urge a return to sounder principles, founded on the conservation of energy and the replenishment of the land.

These principles are of universal application, and it is therefore certain that the advantages which would follow co-operation with them would always outweigh any minor inconvenience that such a course might entail for a time. Thus the grave questions of air and water pollution—evils which now menace the community from this source—would disappear, as the cause from which they spring would no longer exist; other difficulties, which now appear serious, connected with such a change would yield to the ingenuity of experts (which is seldom wanting when it is required), and the final solution of the whole problem on natural lines might safely be left to the process of development and the work of time.

It is said that the nation which neglects its agriculture is at the mercy of its enemies and its competitors, and it may be worth noting that the agriculture of England has declined as the water-carriage system has advanced. It is not, of course, contended that the latter method must be held entirely responsible in producing this result; but, on the other hand, few people would be inclined to question that the proper use of all organic refuse is an all-important factor in the agricultural problem.

In view, therefore, of our insular position, as well as for hygienic reasons, it is certainly incumbent on us to do all that is possible to bring about the highest and most intensive state of cultivation of which our soil is capable, not forgetting the lines of our National Poet: — "The earth . . . that feeds and breeds

from a composture stolen from the general excrement."—*Timon of Athens.*

"To give to the earth is to get from her. To make two ears of wheat grow where but one grew before has been held a worthy ambition, and this can only be adequately and properly done by a system which naturally lends itself to the old injunction to 'replenish the earth and subdue it.'"

". . . . . for all that she demands
Returns us fifty-fold :
Offal and ordure takes she at our hands,
And pays us back in gold."

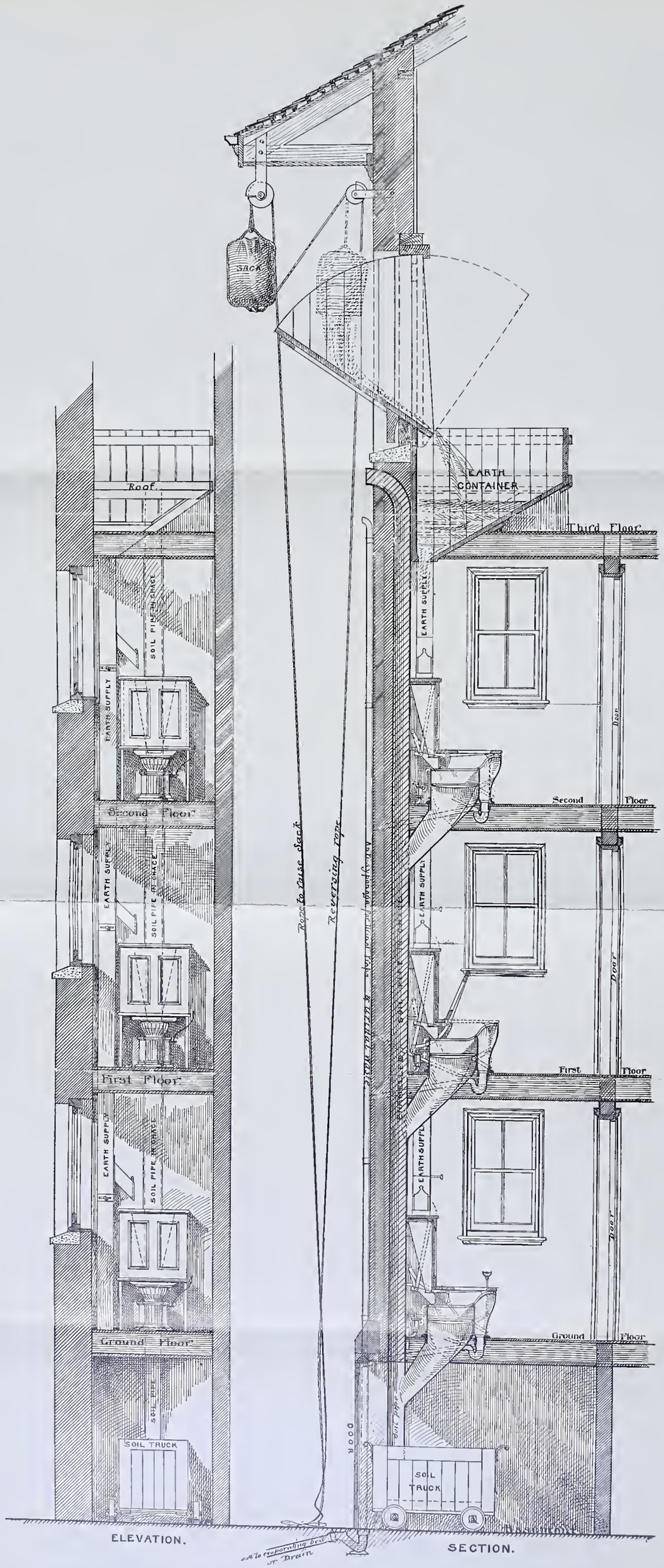
SACK
EARTH CONTAINER
Roof.
Third Floor.
Second Floor.
First Floor.
Ground Floor.
Second Floor
First Floor
Ground Floor
EARTH SUPPLY
SOIL PIPE IN CHASE
SOIL PIPE
SOIL TRUCK
Door
Rope to raise sack
Reversing rope
ELEVATION.
SECTION.

PLATE 7.

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